Communication system for radio travel operations

CLAIM FOR PRIORITY

This application is a national stage of PCT/DE99/03239, published in the German language on April 13, 2000, which claims the benefit of priority to German Application No. DE 198 47 292.7, filed on October 7, 1998.

TECHNICAL FIELD OF THE INVENTION

The invention relates to a communications system for radio travel operations, and in particular, to a communications system for radio travel operation for railway services.

BACKGROUND OF THE INVENTION

Radio travel operations are an operating method with which the "route setting" and "route securing" functions are not implemented on the route, as in the past, but rather on the vehicle. A problem with this is the limited resources in terms of radio channels from the vehicle to the route and the associated long link setup times (typically 20-25 sec. including setup of the securing layer). Multiple radio communications have to be carried out simultaneously from the vehicle as a function of the vehicle speed and the density of vehicle elements, which the vehicle has to set and secure. The radio standard provided for railway applications allows for just one radio channel for data communications per terminal. Even if two mobile radio terminals are used on the vehicle, bottlenecks may occur.

DE 197 21 246 discloses a communications device for radio-supported railway services with which both the data from decentralized control devices and the

data of central services can be transmitted to a train with just a single transmission channel. For this purpose, there are provisions for all this data to be fed to a central gateway computer. The latter then brings about the transmission data to the vehicle. By using a central gateway computer which is assigned to the train, it is possible to transmit all the data in multiplex mode without a new transmission route having to be set up between the vehicle and the central railway services when the train moves forward as a result of the change into a new route region.

Furthermore, in order to avoid long communication paths, DE 198 32 594 describes an optimized communication system for radio-supported traffic services. The system has one or more decentralized gateway computers in addition to the fixed, centralized services and the fixed decentralized control points in the traffic network. The communication between the mobile elements and the fixed elements is implemented via the gateway computers. In each case, a representative element is set up for the mobile elements which communicate with the gateway computers, in the gateway computer and in the fixed elements. For the fixed elements which communicate with the gateway computers, representative elements are set up directly in the gateway computer or indirectly via at least one information server. The representative information is updated in the gateway computer, and in the fixed elements, by means of an update method between the representative elements in the gateway computer and the fixed elements or between the gateway computer and the information server.

This method permits a plurality of logic connections to be multiplexed for a vehicle via a physical radio channel to a gateway, which is associated with a fixed network and which can forward

the links to any desired end point within the fixed network.

SUMMARY OF THE INVENTION

In one embodiment of the invention, there is a communication system for radio travel operations for making radio transmissions of data transmitted in multiplex mode, using at least one gateway computer, wherein the radio links for the transmission of data between vehicles, route elements and a control center are set up via the gateway computer.

In one aspect of the invention, the communication system for radio travel operations, wherein the vehicles and the route elements are equipped with radio terminals, and the radio terminals also include line-bound communications terminals.

In another aspect of the invention, the communication system for radio travel operations, wherein the vehicles are trains and the route elements are railway switches, track locks, key locks, block or level crossings.

In still another aspect of the invention, the communication system for radio travel operations wherein communication between a plurality of trains and a route element is provided.

In yet another aspect of the invention, the method of communicating using multiplexed data radio transmission. The method transmitting the data in radio links between vehicles, route elements and a control center via at least one gateway computer.

BRIEF DESCRIPTION OF THE INVENTION

The invention will be explained in more detail below with reference to one exemplary embodiment which is illustrated at least partially in the figure.

Figure 1 shows a variant of a multiplex link from the vehicle into the control center and to the forwarding to route elements.

DETAILED DESCRIPTION OF THE INVENTION

The invention provides a communication system for radio travel operations which uses simple means to traffic reliable data via effective communication paths with just one radio transmission channel between vehicles and route elements. This ensures simultaneous communication with a plurality of elements and minimizes expenditure on setting up, updating and maintaining the system.

A particular advantage of the invention consists in the fact is that a single mobile terminal on one vehicle is sufficient to be able to communicate simultaneously with a plurality of route elements. This is possible because the radio links for the transmission of data from the vehicles to the route elements are not established directly, but rather are set up via a gateway computer. The price paid for this is that (n+1) radio communications are necessary for communication with n route elements. Without multiplexing, n radio communications are necessary for this. A further application of the gateway functionality in radio travel operations on double-track or multi-track routes generally includes setting up communication with level crossings via the gateway computer. This makes it possible for two or more trains to communicate simultaneously with the level crossing.

Without a gateway computer this would have to take place successively, and could lead to operational impediments.

The communication characteristic of radio travel operations with rapidly changing brief, communications is completely different from that of radio train control. The latter is characterized by the fact that each train has a permanent link to a control center. The communications pattern is therefore quasi-static. The link-oriented communication of radio train control is ideally suited to this and the comparatively long link setup times are not an important factor. This does not apply to radio travel operation. With the present invention, a way is provided of permitting individual data transmission between the trains and the fixed control elements on route sections with a high density of route elements by means of partial elements such as are used - in another method of operation - in radio train control.

A further advantage of the invention is the capability of supplying immediate stop instructions which, when necessary, are sent by radio to the vehicles from the radio travel operations control center can also be transmitted immediately via the multiplex channel in regions with a high route element density. This applies also to high-priority data which are sent by broadcast to all receive-end elements of the multiplex channel.

Figure 1 illustrates an example of a route section composed of two railway switches W1, W2 and a level crossing LC. After the first link request has been implemented from the vehicle F to one of these three route elements (e.g. to the level crossing LC) via the gateway computer, each further link request from the vehicle F to another route element W1, W2 is multiplexed via the same physical link into the control

center Z and forwarded from there to the desired route element W1 or W2 or LC.

The link setup to the route elements W1, W2 or LC can be optimized in this way. Thus, without multiplexing, the three communications would have to be carried out successively. With multiplexing it is possible for the communication phases of the individual communications to take place in a largely chronologically overlapping way.

Each communication is comprised of the three following time elements:

a) switching communication setup, T(GSM) approximately 10 sec mtm or approximately 5 sec moc, mtc

b) setup of the securing layer, T(securing): approximately 15 sec

c) data transmission, T(transmission): approximately 2 sec.

in which:

mtm: mobile to mobile call (from one mobile to another)

moc: mobile originated call (from mobile into the ISDN fixed network)

mtc: mobile terminated call (from the ISDN fixed network to the mobile)

The entire communication duration is therefore:

without multiplexing:

3(T(GSM, mtm) + T (securing) + T (transmission)) = approximately 81 sec.

with multiplexing:

T(GSM to the gateway, moc) + T (GSM to the LC, mtc) + T(securing LC) + T(transmission to the LC) = approximately 27 sec

For the radio travel operations application, the multiplexing via the gateway computer is completely transparent; i.e. it is not visible which path is being used to forward the link. The telegrams do not differ

at the interface to the secure application from telegrams which are forwarded directly (without the detour via the gateway computer) to a route element.